

## Drawings

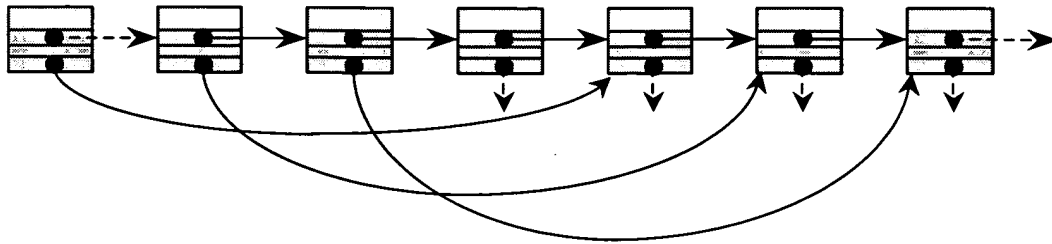


Figure 1: Linked list representation with jump pointers (Prior Art).

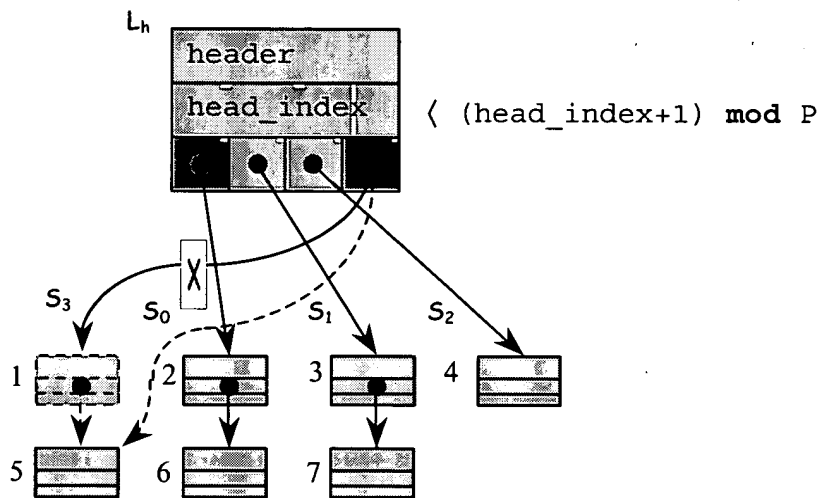


Figure 2: A prefetchable linked list representation.

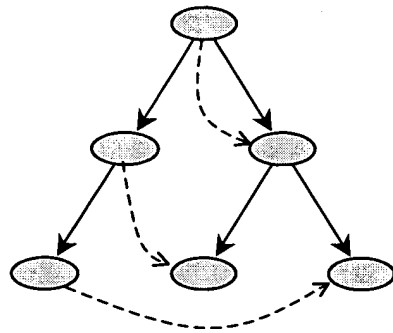


Figure 3: A tree data structure with history pointers (Prior Art).

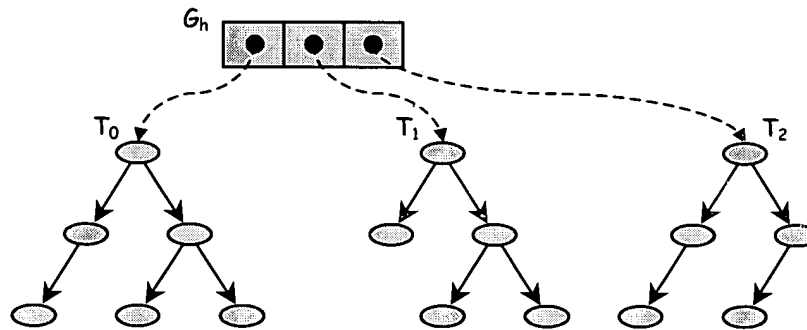


Figure 4: A prefetchable tree representation.

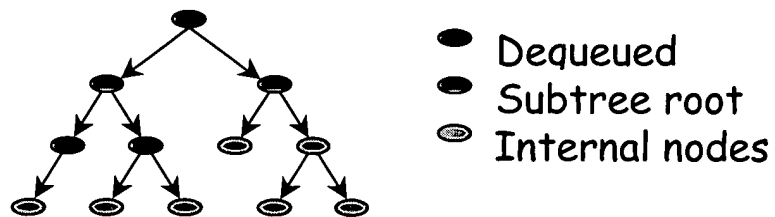
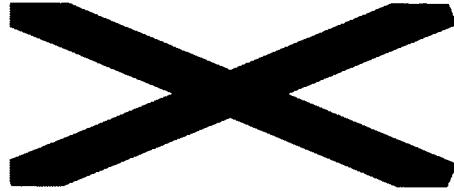
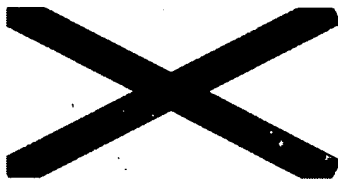


Figure 5: Transforming a Tree into a Forest.



*Figure 6: Performance of prefetched linked list traversals.*



*Figure 7: Performance of prefetched tree traversals.*

```
list_element_ptr process_list( list_ptr list )
{
    int i, p;
    list_element_ptr s[PipeDepth];

    /* prologue */
    p = list->headers;
    for ( i=0, i<p; i++ ) {
        PREFETCH( s[i] = list->head[i] );
    }

    /* steady state */
    while ( p ) {
        for ( i=0; i<p; i++ ) {
            if ( process_element( s[i] ) == STOP )
                return s[i];
            s[i] = s[i]->next;
            PREFETCH( s[i] );
        }
    }
}
```

*Figure 8: Example of a Pipelined Linked List traversal.*

```

 Traverse( forest_ptr forest )
 {
     /* local variables */
     stack stacks[PipeDepth]; /* PipeDepth stacks */
     tree_ptr n;
     int i, trees_left = PipeDepth;
     struct {
         tree_ptr node;
         stack_ptr stack;
     } traversal[PipeDepth]; /* traversal state descriptor */

     /* prologue */
     for ( i=0; i<PipeDepth; i++ ) {
         traversal[i].node = forest->root[i];
         traversal[i].stack = &stack[i];
         PREFETCH(forest->root[i], sizeof(forest->root[i]));
     }

     /* steady state */
     while ( trees_left ) {
         for ( i=0; i<trees_left; i++ ) {
             if ( traversal[i].node->left ) {
                 traversal[i].stack->push( traversal[i].node->left );
                 traversal[i].node = traversal[i].node->left;
             } else {
                 n = traversal[i].stack->pop();
                 if ( n == NULL ) { /* done with tree i */
                     trees_left--;
                     if ( i != trees_left )
                         SWAP( &traversal[i], &traversal[trees_left] );
                 }
                 process( n );
                 traversal[i].node = n->right;
             }
             PREFETCH( traversal[i].node );
         }
     }
 }

```

*Figure 9: Example of a Pipelined Tree Traversal.*

```

Traverse( tree_ptr tree )
{
    /* local variables */
    . . .

    /* level-order traversal prologue */
    PREFETCH( tree->root );
    enqueue( src_queue, tree->root );
    for ( i=0, accumulating=true; accumulating; i++ ) {
        n = dequeue(src_queue);
        if ( n == NULL )
            return;          /* we're done */
        process(n->data);

        if ( n->left != NULL ) {
            PREFETCH( n->left );
            enqueue( dst_queue, n->left );
        }
        if ( n->right != NULL ) {
            PREFETCH( n->right );
            enqueue( dst_queue, n->right );
        }
        if ( src_queue->size + dst_queue->size < PipeDepth ) {
            if ( i >= src_queue->size )
                SWAP( src_queue, dst_queue );
        } else {
            accumulating = false;
            while ( src_queue->size > 0 ) {
                traversal[trees_left].node = dequeue( src_queue );
                traversal[trees_left].stack = stack[trees_left];
                trees_left++;
            }
            while ( dst_queue->size > 0 ) {
                traversal[trees_left].node = dequeue( dst_queue );
                traversal[trees_left].stack = stack[trees_left];
                trees_left++;
            }
        }
    }

    /* steady state loop */
    . . .
}

```

*Figure 10:* Example of a pipelined level-order tree traversal.